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Charge Transfer and Its Methods, About Charge Transfer Complex (For CBSE, ICSE, IAS, NET, NRA 2022)

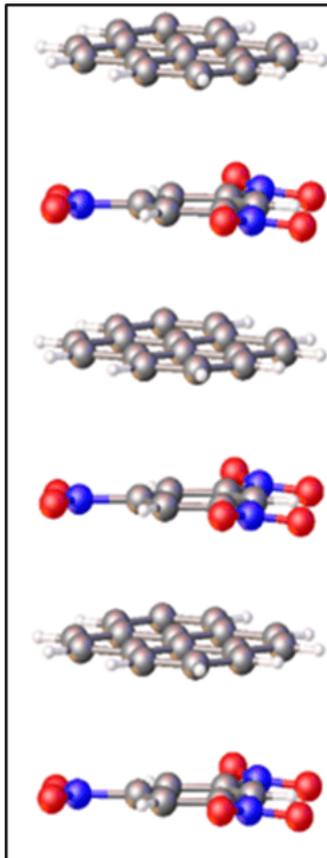
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Charge Transfer and Its Methods

About Charge Transfer Complex

A charge transfer complex also called as the electron donor acceptor complex can be defined as an association of two or more molecules, or of different parts of a large molecule, in which a fraction of electronic charge is transferred between the molecular entities.

Structure of One Part of One Stack of the Charge-Transfer Complex between Pyrene



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- We all have observed that when we charge a piece of plastic, a comb or a pen and position it near small pieces of paper they get attracted towards it.
- Also; the comb loses its charge after a few moments. One can say the charge gets transferred to our hand and eventually to the ground. But how does this phenomenon occur?

Methods of Charge Transfer

There are two methods through which charge transfer can take place between two bodies.

- Charge transfer by Conduction

- Charge transfer by Induction

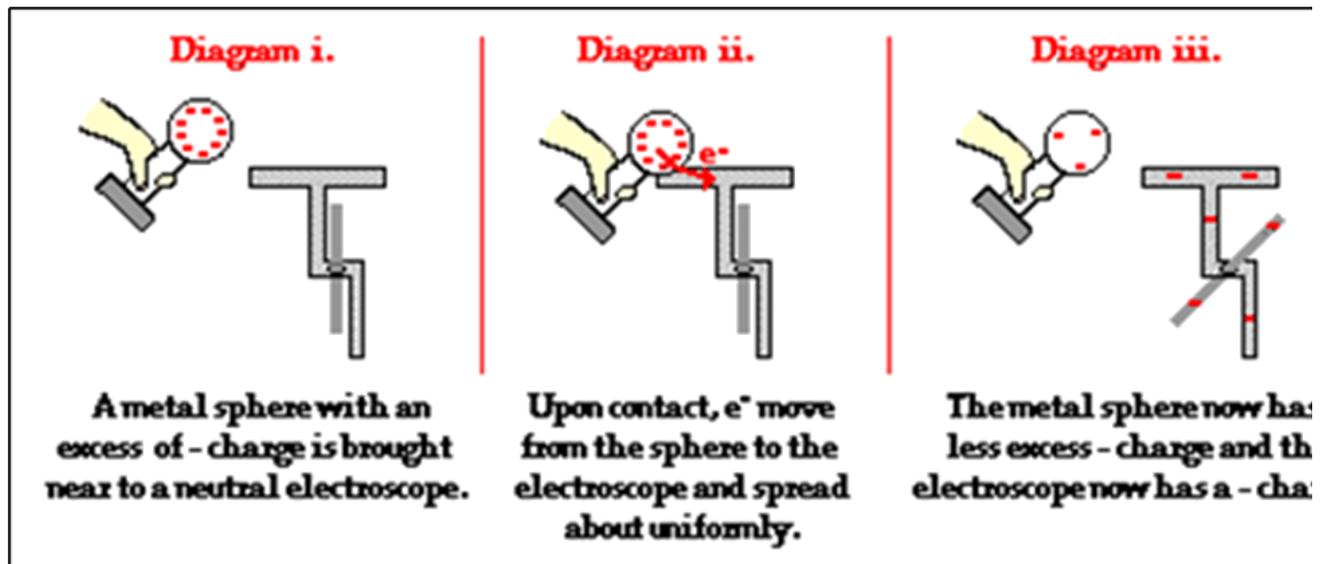
Charge Transfer by Conduction

- Charging by conduction involves the contact of a charged object to a neutral object.
- So, when an uncharged conductor is brought in contact with a charged conductor, charge is shared between the two conductors and hence the uncharged conductor gets charged.
- During charging by conduction, both objects acquire the same type of charge.
- The charge transfer by conduction process involves touching of a charged particle to a conductive material.
- This way the charges are transferred from the charged material to the conductor. This method is useful for charging conductors.

Charge Transfer by Conduction Using a Negatively Charged Object

- To explain the process of charging by contact, first consider the case of using a negatively charged metal sphere to charge a neutral needle electroscopescope.
- Understanding the process demands that you understand that like charges repel and have an intense desire to reduce their repulsions by spreading about as far as possible.

Charging of a Neutral Object by Conduction



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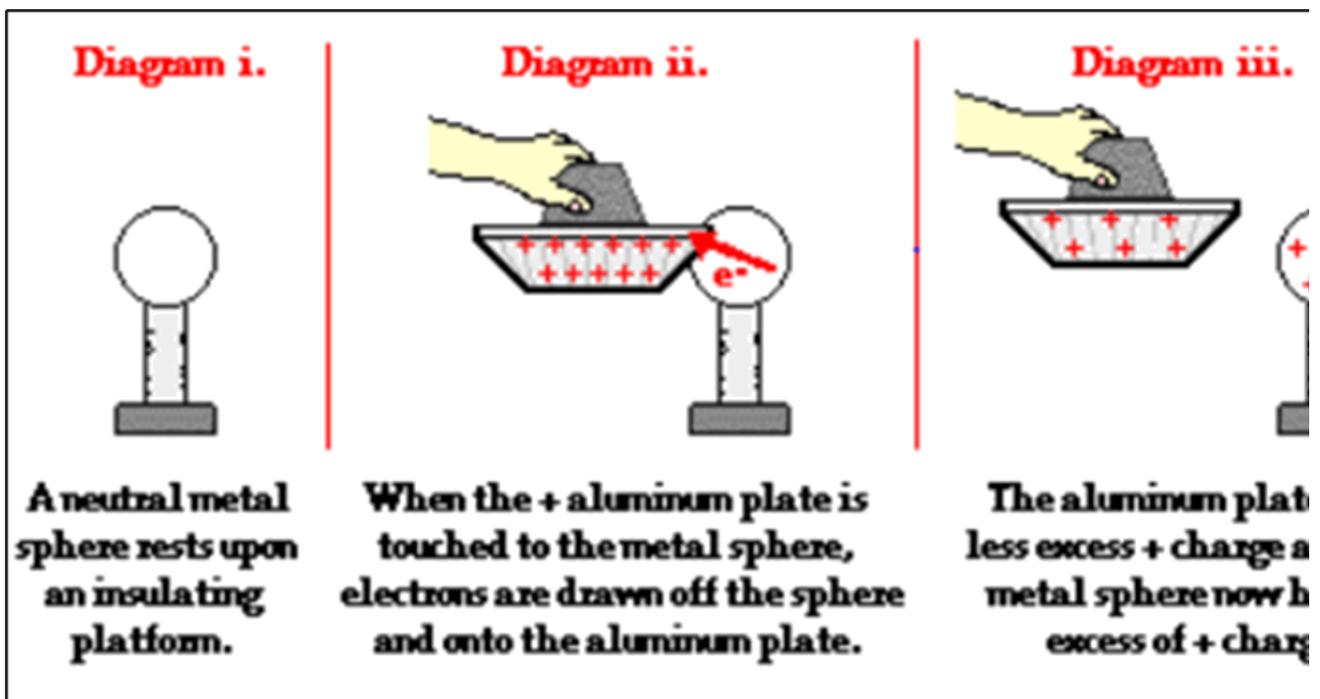
- A negatively charged metal sphere has an excess of electrons; those electrons find each other repulsive and distance themselves from each other as far as possible.
- The perimeter the sphere is the extreme to which they can go.
- If there was ever a conducting pathway to a more spacious piece of real estate, one could be sure that the electrons would be on that pathway to the greener grass beyond.
- So, electrons living in the same home despise each other and are always seeking a home of their own or at least a home with more rooms.

- Given this electron-electron repulsion, it is not difficult to predict what excess electrons on the metal sphere would be inclined to do if the sphere were touched to the neutral electroscope.
- Once the contact of the sphere to the electroscope is made, many numbers of excess electrons from the sphere move onto the electroscope and spread about the sphere-electroscope system.
- The object that offers the most space in which to “hang out” will be the object that houses the greatest number of excess electrons.
- When the charging process by conduction is complete, the electroscope acquires an excess negative charge due to the movement of electrons onto it from the metal sphere.
- The metal sphere is still charged negatively, only it has less excess negative charge than it had prior to the conduction charging process.

Charge Transfer by Conduction Using a Positively Charged Object

- The diagram shown below depicts the use of a positively charged aluminum plate being touched to a neutral metal sphere.
- A positively charged aluminum plate has an excess of protons.
- When looked at from an electron perspective, a positively charged aluminum plate has a shortage of electrons. So, we could say that each excess proton is rather discontented.
- It's not satisfied until it has found a negatively charged electron with which to co-habitat.
- Though, a proton is tightly bound in the nucleus of an atom, it is incapable of leaving an atom in search of that longed-for electron.
- It can attract a mobile electron towards itself and if a conducting pathway is made between a collection of electrons and an excess proton, one can be certain that there is likely an electron that would be willing to take the pathway.
- When the positively charged aluminum, plate is touched to the neutral metal sphere, countless electrons on the metal sphere migrate towards the aluminum plate.
- There is a mass migration of electrons until the positive charge on the aluminum plate-metal sphere system becomes redistributed.
- Having lost electrons to the positively charged aluminum plate, there is a shortage of electrons on the sphere and an overall positive charge.
- The aluminum plate is still charged positively; only it now has less excess positive charge than it had before the charging process began.

Charge Transfer by Conduction Using a Positively Charged Object



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In the above example, we learnt about charge transfer through the process of conduction using a positive or a negatively charged object. Charge transfer can also take place through the process of induction.

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